

WHAT IS CLAIMED IS:

1. An electrochemical method of detecting a selected nucleic acid segment comprising
- 5 a) providing an electrochemical cell including a working electrode;
- b) providing a biological probe capable of hybridizing to said selected nucleic acid segment and coupling to said working electrode;
- c) hybridizing said biological probe with said selected nucleic acid segment and coupling said biological probe to said working electrode such that in
- 10 the presence of an amperometric potential an electrochemical current is generated; and
- d) detecting said electrochemical current.
2. The electrochemical method of claim 1 wherein said working electrode is a colloidal gold working electrode;
- 15 3. The electrochemical method of claim 1 wherein said biological probe includes an oligonucleotide.
4. The electrochemical method of claim 3 wherein said biological probe includes an electroactive label.
5. The electrochemical method of claim 1 wherein a second biological probe capable
- 20 of hybridizing to the selected target nucleic acid sequence is present.

6. The electrochemical method of claim 5 wherein said second biological probe includes an electroactive label.
7. The electrochemical method of claim 5 wherein said second biological probe includes an oligonucleotide.
- 5 8. The electrochemical method of claim 2, wherein said working electrode comprises a carbon electrode coated with colloidal gold.
9. The electrochemical method of claim 2, wherein said colloidal gold electrode includes a component reactive with said biological probe such that said biological probe bonds with said colloidal gold electrode.
- 10 10. The electrochemical method of claim 9, wherein said component comprises streptavidin, avidin, a derivative of avidin, or an oligonucleotide.
11. The electrochemical method of claim 9, wherein said biological probe includes biotin.
12. The electrochemical method as defined in claim 4, wherein said electroactive label is fluorescein, dioxigenin, biotin, or a thiol group.
- 15 13. The electrochemical method as defined in claim 4, wherein said electroactive label is reactive with an electroactive reporter group.

14. The electrochemical method as defined in claim 13, wherein said electroactive reporter molecule is horseradish peroxidase, alkaline phosphatase or microperoxidase.
15. The electrochemical method as defined in claim 1, wherein said electrochemical current is generated in the presence of an electron transfer mediator and a substrate.
16. The electrochemical method as defined in claim 15, wherein in said electron transfer mediator is 3,3',5,5'-tetramethylbenzidine, ferrocene monocarboxylic acid or 2,2'-azino-bis[3-ethylbenzothiazoline-6-sulfonic acid] and said substrate is hydrogen peroxide.
17. The electrochemical method as defined in claim 1, wherein said selected target nucleic acid segment comprises a portion of a bacterium, virus, parasite or microbe.
18. The electrochemical method as defined in claim 1, wherein said selected target nucleic acid segment comprises a portion of a cancer cell.
19. Apparatus for electrochemically detecting a selected target nucleic acid segment, which apparatus comprises
- a) an electrochemical cell which includes a reference electrode, and a working electrode comprising a colloidal gold component; and

- b) a second component capable of bonding to a biological probe hybridizable with said selected target nucleic acid segment.

20. An apparatus as defined in claim 19, wherein said second component comprises a streptavidin, avidin, a derivative of avidin or an oligonucleotide.

5 21. An apparatus as defined in claim 19, wherein said selected target nucleic acid segment comprises a portion of a pathogen.

22. An apparatus as defined in claim 19, wherein said selected target nucleic acid segment comprises a portion of a diseased cell.

10 23. Apparatus for detecting a selected target nucleic acid segment, said apparatus comprising:

- a) an electrochemical cell comprising a plastic substrate defining a sample well capable of receiving a sample of said selected target nucleic acid segment, and including a reference electrode and a working electrode comprising colloidal gold, said electrodes positioned in said well to contact a said sample;

- 15 b) a container containing a liquid suspected of containing said selected target nucleic acid segment, a biological probe hybridizable with said selected target nucleic acid segment and capable of bonding to said working electrode;

- c) means for transferring a sample of said liquid from said container into said sample well and into contact with said electrodes; and
- d) an electrometric device connectable to said working electrode to detect an electrical signal on said working electrode.

5 24. A method of electrochemical detection of a pathogen comprising:

- a) hybridizing a capture probe to a first DNA region of a selected target nucleic acid segment;
- b) hybridizing a detection probe to a second DNA region of said selected target nucleic acid segment; and
- 10 c) connecting said hybridized capture probe to a colloidal gold working electrode of an electrochemical cell containing a liquid suspected of containing said selected target nucleic acid segment.

25. A method of detecting a pathogen comprising a selected target nucleic acid segment, which method comprises:

- 15 a) providing an electrochemical cell including a colloidal gold working electrode and aqueous medium suspected of containing said pathogen;
- b) adding to the aqueous medium

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- i) a first biological probe capable of bonding to the colloidal gold working electrode and hybridizing to said selected target nucleic acid segment;
 - ii) a second biological probe labelled with a molecule reactive with an electrochemical reporter group and capable of hybridizing with said selected target nucleic acid segment; and
 - iii) said electrochemical reporter
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- c) oxidizing the electrochemical reporter to thereby generate an electrical signal in the cell depending on the presence of said selected target nucleic acid segment in said aqueous medium; and
 - d) detecting the presence of any such generated signal.

26. A method of detecting a water-borne pathogen comprising a selected target nucleic acid segment, which method comprises:

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- a) providing an electrochemical cell including a colloidal gold working electrode and an aqueous sample containing the pathogen;
 - b) coupling a first biological probe to the colloidal gold electrode;
 - c) coupling a second biological probe to an oxidizable electroactive enzyme;
 - d) oxidizing said electroactive enzyme to thereby generate an electrical current within the cell; and

- 5 e) detecting said generated electrical current at the colloidal gold electrode.
27. Apparatus for testing aqueous medium for the presence of an identified nucleic acid sequence which said apparatus comprises:
- 5 a) an electrochemical cell configured to receive a sample of said aqueous medium; and
- b) including a working electrode comprising colloidal gold in combination with a component capable of coupling with a capture probe capable of hybridizing with said identified nucleic acid sequence.
28. The apparatus of claim 27 wherein said cell further includes a reference electrode.
- 10 29. The apparatus of claim 28 wherein said cell further includes a counter electrode.
30. A working electrode which comprises colloidal gold in combination with a component capable of coupling with an oligonucleotide probe.
31. The working electrode of claim 30 wherein said component comprises avidin or a substance having a said coupling capability similar to avidin.
- 15 32. Apparatus as defined in claim 27 wherein a second identified nucleic acid sequence is attached to said first identified nucleic acid sequence, and wherein said apparatus further comprises a detector probe capable of hybridizing with said second identified nucleic acid sequence and including an electroactive label activatable to generate a flow of electrons in said cell.

33. A method of testing aqueous medium for the presence of a pathogen identified by an identified nucleic acid sequence and including an electroactive label, said method comprising:

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- a) providing an electrochemical cell and a working electrode as defined in claim27;
 - b) placing a sample of the aqueous medium in the cell;
 - c) coupling with the working electrode a capture probe capable of hybridizing with said identified nucleic acid sequence;
 - d) hybridizing the capture probe with said identified nucleic acid sequence;
 - 10 and
 - e) imposing conditions on the cell capable of activating said electroactive label.

34. The method of claim 33 wherein said electroactive label is a normal component of said identified nucleic acid sequence and said conditions comprise a sufficient electrical potential, and wherein said method further comprises imposing said

15 sufficient electrical potential on the cell.

35. The method of claim 34 wherein said electroactive label is attached to said identified nucleic acid sequence.

36. The method of claim 35, wherein said identified nucleic acid sequence includes a second identified nucleic acid sequence and said electroactive label is attached to the second identified nucleic acid sequence by a detector probe.

37. An electrochemical detection kit comprising:

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- a) an electrochemical cell wherein said cell includes a working electrode and a reference electrode;
- b) a biological probe capable of hybridizing to an identified nucleic acid sequence and coupling to said working electrode; and
- c) an electrochemical means of detection.